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# APPENDIX A

(CLEAN VERSION OF SUBSTITUTE SPECIFICATION EXCLUDING CLAIMS)

(Attorney Docket No.: 4848US)

# PROCESS AND EQUIPMENT FOR HOT MOULDING OF ARTICLES MADE OF THERMOPLASTIC MATERIAL

## BACKGROUND OF THE INVENTION

**[0001]** Field of the Invention: The present invention relates to a process and equipment for the hot moulding of articles made of thermoplastic material.

**[0002]** State of the Art: The invention has been developed in particular for the moulding of panels for lining the interiors of motor vehicles. A conventional technology for the production of lining panels involves heating of at least one plate of thermoplastic material to a plasticizing temperature and setting the plate, together with a possible upholstery sheet, between two half-moulds of an apparatus for hot moulding, which are provided with respective moulding surfaces set opposite one another. Hot moulding involves the application of pressure on opposite surfaces of the plate in a plastic state, thus bestowing on the plate the desired shape. Normally, during moulding of the plate, also an upholstery sheet is applied on one surface of the plate itself. When panels are produced for internal lining of motor vehicles, it is often necessary to fix, on the rear surface of the panel, one or more inserts forming an anchoring seat for a fixing means, such as a screw, a snap-in pin, or the like. Normally, these inserts are produced by injection moulding separately from the hot moulding of the panel, and are subsequently fixed by welding on the rear surface of the moulded plate. Alternatively, the inserts produced by injection moulding may be fixed on the plate during hot moulding of the plate itself. In this case, the inserts are positioned in the hot-moulding equipment and are mechanically anchored to the plate during moulding.

**[0003]** The latter approach requires injection-moulding equipment independent of the hot-moulding equipment and involves an operating step in which the inserts are fixed onto the moulded plates, or else a step in which the inserts are positioned on the moulding equipment.

## SUMMARY OF THE INVENTION

**[0004]** The object of the present invention is to provide a process and equipment for hot moulding of articles made of thermoplastic material, which will enable a reduction in the cost of the finished articles and a simplification of the production cycle.

[0005] According to the present invention, the above subject is achieved by a process and equipment having the characteristics specified in the claims.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0006] The present invention will now be described in detail with reference to the attached drawings, which are provided purely to furnish a non-limiting example, and in which:

[0007] Figure 1 is a schematic partial section of hot-moulding equipment according to the present invention;

[0008] Figures 2 and 3 are schematic sections illustrating the equipment of Figure 1 in various steps of the operating cycle;

[0009] Figure 4 is a schematic perspective view of the part indicated by the arrow IV in Figure 3; and

[0010] Figure 5 is a detail at an enlarged scale of the part indicated by the arrow V in Figure 3.

#### DETAILED DESCRIPTION OF THE INVENTION

[0011] With reference to Figures 1-3, the numbers 10 and 12 respectively designate a top half-mould and a bottom half-mould of a hot-moulding apparatus. The half-moulds 10, 12 have respective moulding surfaces 14, 16, which are set opposite each other and are designed to apply a moulding pressure on a plate L of thermoplastic material, following upon movement from an open position to a closed position.

[0012] Figure 1 illustrates the half-moulds in a closed position, at the end of hot moulding of the plate L. The plate L is first heated up to a plasticizing temperature and is set between the two half-moulds 10, 12 while these are in the open position. An upholstery sheet R may be set between the two half-moulds together with the plate L so that it will be applied on one surface of the plate L during moulding of the latter. The half-moulds 10, 12 are provided, in a conventional way, with a cooling system in order to ensure that, during the moulding operation, the plate L will be cooled down to a temperature substantially lower than the plasticizing temperature of the thermoplastic material.

[0013] One of the two half-moulds (in the example illustrated, the bottom half-mould 12) is provided with at least one injection-moulding seat 18, which communicates with an injection channel 20. The seat 18 is designed to form an insert 22 having, for instance, the shape illustrated in Figure 4. The insert 22, illustrated to provide an example in Figure 4, comprises a portion 24 containing a hole 26 with its axis substantially orthogonal to the plate L. The portion 24 is connected to the plate L<sub>3</sub> via three walls 28 fixed to the plate L, each along one of its edges 30.

[0014] Figure 1 illustrates the configuration of the moulding equipment at the end of the hot-moulding step and before injection of plastic material into the injection-moulding seat 18. The seat 18 is defined between one portion of the mould 12 and a slider 32 which is mobile with respect to the half-mould 12 to enable extraction of the insert 22 that is formed in the seat 18. The slider 32 has a surface 34 which constitutes a portion of the hot-moulding surface of the half-mould 12.

[0015] As may be seen in Figure 1, the moulding seat 18 communicates with the hot-moulding surface 16, 34 by means of a narrow section 36 which constitutes the joining edge 30 between the insert 22 and the plate L. The narrow section 36 has a surface substantially smaller than that of the transverse section of the remaining part of the cavity 18, so as to produce, at the narrow section 36, a marked reduction in the pressure of the plastic material injected into the moulding seat 18.

[0016] With reference to Figure 2, after hot moulding of the plate L has been completed, and after partial cooling of the plate L by contact with the half-moulds 10, 12, plastic material compatible with the thermoplastic matrix of the plate L is injected into the injection-moulding seat 18. The injection of plastic material is performed according to a technology typical of injection moulding of plastic materials. For example, the plastic material may be propylene-based and may be injected at pressures in the region of 600-1000 bar and at a temperature in the region of 180°C. The narrow section 36 of contact between the moulding seat 18 and the plate L reduces the pressure against the plate L of the injected material and thus prevents the injected material from damaging the plate L and the upholstery sheet R. The dimensions of the narrow section 36 can be varied according to the parameters of the injection process so as to prevent

damage to the plate and, at the same time, to obtain a surface for mutual fixing between the insert 22 and the plate L that is sufficiently large for providing firm anchorage.

**[0017]** As illustrated in Figure 3, after the insert 22 has been obtained by injection moulding, the half-moulds 10, 12 are brought into the open position and, at the same time, the slider 32 is displaced with respect to the half-mould 12 in the direction indicated by the arrow A so as to enable extraction of the insert 22 from the seat 18. As illustrated in Figures 3 and 5, the insert 22 is anchored to the plate L along the edge 30 having a narrow section. The number of inserts 22 fixed to the plate L may vary according to the particular requirements. Also the shape and size of each insert 22 may vary widely with respect to what is described and illustrated herein purely for the purpose of providing an example.

## ABSTRACT OF THE DISCLOSURE

A process for the hot moulding of articles (L) made of thermoplastic material, comprising the steps of:

- heating at least one plate of thermoplastic material (L) to a plasticizing temperature;
- compressing said heated plate (L) between two moulding surfaces (14, 16), set opposite one another, of a pair of half-moulds (10, 12); and
- forming, by injection moulding, at least one component (22) anchored to a surface of the plate (L), while the plate is being compressed between said moulding surfaces (14, 16).

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# **APPENDIX B**

**(VERSION OF SUBSTITUTE SPECIFICATION EXCLUDING CLAIMS  
WITH MARKINGS TO SHOW CHANGES MADE)**

**(Attorney Docket No.: 4848US)**

# PROCESS AND EQUIPMENT FOR HOT MOULDING OF ARTICLES MADE OF THERMOPLASTIC MATERIAL

## [TEXT OF DESCRIPTION] BACKGROUND OF THE INVENTION

**[0001]** Field of the Invention: The present invention relates to a process and equipment for the hot moulding of articles made of thermoplastic material.

**[0002]** State of the Art: The invention has been developed in particular for the moulding of panels for lining the interiors of motor vehicles. A conventional technology for the production of lining panels involves heating of at least one plate of thermoplastic material to a plasticizing temperature and setting the plate, together with a possible upholstery sheet, between two half-moulds of an apparatus for hot moulding, which are provided with respective moulding surfaces set opposite one another. Hot moulding involves the application of pressure on opposite surfaces of the plate in a plastic state, thus bestowing on the plate the desired shape. Normally, during moulding of the plate, also an upholstery sheet is applied on one surface of the plate itself. When panels are produced for internal lining of motor vehicles, it is often necessary to fix, on the rear surface of the panel, one or more inserts forming an anchoring seat for a fixing means, such as a screw, a snap-in pin, or the like. Normally, these inserts are produced by injection moulding separately from the hot moulding of the panel, and are subsequently fixed by welding on the rear surface of the moulded plate. Alternatively, the inserts produced by injection moulding may be fixed on the plate during hot moulding of the plate itself. In this case, the inserts are positioned in the hot-moulding equipment and are mechanically anchored to the plate during moulding.

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**[0008]** Figures 2 and 3 are schematic sections illustrating the equipment of Figure 1 in various steps of the operating cycle;

**[0009]** Figure 4 is a schematic perspective view of the part indicated by the arrow IV in Figure 3; and

**[0010]** Figure 5 is a detail at an enlarged scale of the part indicated by the arrow V in Figure 3.

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**[0013]** One of the two half-moulds (in the example illustrated, the bottom half-mould 12) is provided with at least one injection-moulding seat 18, which communicates with an injection channel 20. The seat 18 is designed to form an insert 22 having, for instance, the shape illustrated in Figure 4. The insert 22, illustrated to provide an example in Figure 4, comprises a portion 24 containing a hole 26 with its axis substantially orthogonal to the plate L. The portion 24 is connected to the plate L<sub>3</sub> via three walls 28 fixed to the plate L, each along one of its edges 30.

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**[0015]** As may be seen in Figure 1, the moulding seat 18 communicates with the hot-moulding surface 16, 34 by means of a narrow section 36 which constitutes the joining edge 30 between the insert 22 and the plate L. The narrow section 36 has a surface substantially smaller than that of the transverse section of the remaining part of the cavity 18, so as to produce, at the narrow section 36, a marked reduction in the pressure of the plastic material injected into the moulding seat 18.

**[0016]** With reference to Figure 2, after hot moulding of the plate L has been completed, and after partial cooling of the plate L by contact with the half-moulds 10, 12, plastic material compatible with the thermoplastic matrix of the plate L is injected into the injection-moulding seat 18. The injection of plastic material is performed according to a technology typical of injection moulding of plastic materials. For example, the plastic material may be propylene-based and may be injected at pressures in the region of 600-1000 bar and at a temperature in the region of 180°C. The narrow section 36 of contact between the moulding seat 18 and the plate L reduces the pressure against the plate L of the injected material and thus prevents the injected material from damaging the plate L and the upholstery sheet R. The dimensions of the narrow section 36 can be varied according to the parameters of the injection process so as to prevent

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**[0017]** As illustrated in Figure 3, after the insert 22 has been obtained by injection moulding, the half-moulds 10, 12 are brought into the open position and, at the same time, the slider 32 is displaced with respect to the half-mould 12 in the direction indicated by the arrow A so as to enable extraction of the insert 22 from the seat 18. As illustrated in Figures 3 and 5, the insert 22 is anchored to the plate L along the edge 30 having a narrow section. The number of inserts 22 fixed to the plate L may vary according to the particular requirements. Also the shape and size of each insert 22 may vary widely with respect to what is described and illustrated herein purely for the purpose of providing an example.

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- forming, by injection moulding, at least one component (22) anchored to a surface of the plate (L), while the plate is being compressed between said moulding surfaces (14, 16).

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	1990	1991	1992
1. Total	100	100	100
2. Government	100	100	100
3. Private	100	100	100
4. Total	100	100	100
5. Government	100	100	100
6. Private	100	100	100
7. Total	100	100	100
8. Government	100	100	100
9. Private	100	100	100
10. Total	100	100	100
11. Government	100	100	100
12. Private	100	100	100
13. Total	100	100	100
14. Government	100	100	100
15. Private	100	100	100
16. Total	100	100	100
17. Government	100	100	100
18. Private	100	100	100
19. Total	100	100	100
20. Government	100	100	100
21. Private	100	100	100
22. Total	100	100	100
23. Government	100	100	100
24. Private	100	100	100
25. Total	100	100	100
26. Government	100	100	100
27. Private	100	100	100
28. Total	100	100	100
29. Government	100	100	100
30. Private	100	100	100
31. Total	100	100	100
32. Government	100	100	100
33. Private	100	100	100
34. Total	100	100	100
35. Government	100	100	100
36. Private	100	100	100
37. Total	100	100	100
38. Government	100	100	100
39. Private	100	100	100
40. Total	100	100	100
41. Government	100	100	100
42. Private	100	100	100
43. Total	100	100	100
44. Government	100	100	100
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46. Total	100	100	100
47. Government	100	100	100
48. Private	100	100	100
49. Total	100	100	100
50. Government	100	100	100
51. Private	100	100	100
52. Total	100	100	100
53. Government	100	100	100
54. Private	100	100	100
55. Total	100	100	100
56. Government	100	100	100
57. Private	100	100	100
58. Total	100	100	100
59. Government	100	100	100
60. Private	100	100	100
61. Total	100	100	100
62. Government	100	100	100
63. Private	100	100	100
64. Total	100	100	100
65. Government	100	100	100
66. Private	100	100	100
67. Total	100	100	100
68. Government	100	100	100
69. Private	100	100	100
70. Total	100	100	100
71. Government	100	100	100
72. Private	100	100	100
73. Total	100	100	100
74. Government	100	100	100
75. Private	100	100	100
76. Total	100	100	100
77. Government	100	100	100
78. Private	100	100	100
79. Total	100	100	100
80. Government	100	100	100
81. Private	100	100	100
82. Total	100	100	100
83. Government	100	100	100
84. Private	100	100	100
85. Total	100	100	100
86. Government	100	100	100
87. Private	100	100	100
88. Total	100	100	100
89. Government	100	100	100
90. Private	100	100	100
91. Total	100	100	100
92. Government	100	100	100

	1990	1991	1992
1. Total	100	100	100
2. Non-union	100	100	100
3. Union	100	100	100
4. Total	100	100	100
5. Non-union	100	100	100
6. Union	100	100	100
7. Total	100	100	100
8. Non-union	100	100	100
9. Union	100	100	100
10. Total	100	100	100
11. Non-union	100	100	100
12. Union	100	100	100
13. Total	100	100	100
14. Non-union	100	100	100
15. Union	100	100	100
16. Total	100	100	100
17. Non-union	100	100	100
18. Union	100	100	100
19. Total	100	100	100
20. Non-union	100	100	100
21. Union	100	100	100
22. Total	100	100	100
23. Non-union	100	100	100
24. Union	100	100	100
25. Total	100	100	100
26. Non-union	100	100	100
27. Union	100	100	100
28. Total	100	100	100
29. Non-union	100	100	100
30. Union	100	100	100
31. Total	100	100	100
32. Non-union	100	100	100
33. Union	100	100	100
34. Total	100	100	100
35. Non-union	100	100	100
36. Union	100	100	100
37. Total	100	100	100
38. Non-union	100	100	100
39. Union	100	100	100
40. Total	100	100	100
41. Non-union	100	100	100
42. Union	100	100	100
43. Total	100	100	100
44. Non-union	100	100	100
45. Union	100	100	100
46. Total	100	100	100
47. Non-union	100	100	100
48. Union	100	100	100
49. Total	100	100	100
50. Non-union	100	100	100
51. Union	100	100	100
52. Total	100	100	100
53. Non-union	100	100	100
54. Union	100	100	100
55. Total	100	100	100
56. Non-union	100	100	100
57. Union	100	100	100
58. Total	100	100	100
59. Non-union	100	100	100
60. Union	100	100	100
61. Total	100	100	100
62. Non-union	100	100	100
63. Union	100	100	100
64. Total	100	100	100
65. Non-union	100	100	100
66. Union	100	100	100
67. Total	100	100	100
68. Non-union	100	100	100
69. Union	100	100	100
70. Total	100	100	100
71. Non-union	100	100	100
72. Union	100	100	100
73. Total	100	100	100
74. Non-union	100	100	100
75. Union	100	100	100
76. Total	100	100	100
77. Non-union	100	100	100
78. Union	100	100	100
79. Total	100	100	100
80. Non-union	100	100	100
81. Union	100	100	100
82. Total	100	100	100
83. Non-union	100	100	100
84. Union	100	100	100
85. Total	100	100	100
86. Non-union	100	100	100
87. Union	100	100	100
88. Total	100	100	100
89. Non-union	100	100	100
90. Union	100	100	100
91. Total	100	100	

## CLAIMS

1. A process for the hot moulding of articles made of thermoplastic material, comprising the steps of:

- heating at least one plate of thermoplastic material to a plasticizing temperature;
- compressing said heated plate between two moulding surfaces, set opposite one another, of a pair of half-moulds; and
- forming, by injection moulding, at least one component anchored to a surface of the plate, while the plate is being compressed between said moulding surfaces.

2. A process according to Claim 1, wherein the injection moulding of the aforesaid component is performed by injecting plastic material at high pressure into a seat communicating with one of said moulding surfaces.

3. A process according to Claim 2, wherein said seat presents a narrow section designed to produce a reduction in the pressure of the plastic material injected in contact with the plate.

4. A process according to Claim 1, comprising the step of displacing a slider defining one part of said seat for extracting the injection-moulded component from the respective seat.

5. Equipment for hot moulding of articles made of thermoplastic material, comprising a first half-mould and a second half-mould which are free to move with respect to one another between an open position and a closed position and are provided with respective moulding surfaces designed to carry out hot moulding of at least one plate of thermoplastic material, at least one of said half-moulds comprising at least one injection-moulding seat communicating with the respective hot-moulding surface, at least one injection channel being provided for injecting plastic material inside said seat.

6. Equipment according to Claim 5, wherein the said injection-moulding seat presents a narrow section designed to reduce the pressure of the plastic material injected in contact with the plate.

7. Equipment according to Claim 5, wherein the half-mould provided with said injection-moulding seat carries a slider which is mobile with respect to the half-mould between an operating position in which the slider defines a part of said injection-moulding seat and a non-operating position in which the injection-moulded component can be extracted from the seat.